

**SANITARY SEWER EVALUATION REPORT  
PHASE II**

**NAVAL AIR STATION - JRB  
FORT WORTH, TEXAS**

PREPARED FOR

**SOUTHERN DIVISION  
NAVAL FACILITIES ENGINEERING COMMAND**  
CONTRACT NO. N62467-92-D-1012

PREPARED BY



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**TABLE OF CONTENTS**  
**SANITARY SEWER SYSTEM EVALUATION REPORT**

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<b>Description</b>	<b>Page</b>
Table of Contents .....	i
List of Tables .....	ii
List of Figures .....	ii
<b>1.0 Introduction .....</b>	<b>1-1</b>
1.1 Purpose of Study .....	1-1
1.2 Infiltration/Inflow Definitions.....	1-2
1.3 Sanitary Sewer Survey .....	1-2
1.3.1 Project Start-up.....	1-3
1.3.2 Gravity Sewer Cleaning/Television Inspection .....	1-3
1.4 Analysis.....	1-4
<b>2.0 Background Information .....</b>	<b>2-1</b>
2.1 General Background .....	2-1
2.2 Description of Existing Conditions .....	2-1
2.3 Existing Collection System .....	2-3
<b>3.0 Inspection Results .....</b>	<b>3-1</b>
3.1 Gravity Sewer Inspections .....	3-1
3.1.1. Cleaning .....	3-1
3.1.2 Televising .....	3-2
<b>4.0 Recommended Rehabilitation .....</b>	<b>4-1</b>
4.1 Rehabilitation Summary.....	4-1
4.2 Recommended Gravity Sewer Rehabilitation.....	4-1

---

## LIST OF TABLES

---

Table Number	Description	Page
3.1.1	Gravity Sewer Inspection Summary .....	3-2
3.1.2	Gravity Sewer Inspection Results .....	3-3
3.1.3	Inaccessible Line Segments.....	3-7
4.1.1	Gravity Sewer Rehabilitation Summary for Defects Requiring Immediate Repair .....	4-11
4.1.2	Gravity Sewer Rehabilitation Summary for Defects Requiring Repair Before June 2000.....	4-12
4.1.3	Gravity Sewer Rehabilitation Summary for Defects Requiring Repair Before June 2001.....	4-13
4.2	Gravity Sewers To Be Monitored .....	4-14

---

## LIST OF FIGURES

---

Figure Number	Description	Page
2.1.1	Site Location Map.....	2-3
2.1	Sewer System Map Line Segment Locations .....	End of Report
4.1	Sewer System Rehabilitation Locations .....	End of Report

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## 1.0 INTRODUCTION

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Metcalf & Eddy (M&E) was retained by the Southern Division Naval Facilities Engineering Command to perform the Phase II Sanitary Sewer System Evaluation Study at Naval Air Station - Joint Reserve Base (NAS-JRB) Fort Worth, Texas. The Phase II evaluation included cleaning and televising of approximately 34,000 feet of sanitary sewers on base. M&E subcontracted with Specialized Maintenance Services, Inc. (SMS) of Pasadena, Texas for cleaning and televising work. A report prepared by SMS has been submitted separately to SOUTHDIV and NAS-JRB as a supplement to this report. This report summarizes the inspection activities completed, provides an evaluation of the inspected wastewater structures, and recommends a rehabilitation program for the NAS-JRB.

### 1.1 Purpose of Study

The purpose of the sanitary sewer system evaluation study is to identify sources of infiltration and inflow (I/I) and structural deficiencies in the gravity sewer lines which when repaired could improve the performance and reliability of the wastewater collection system. The identified defects were evaluated and a rehabilitation program is recommended based on the evaluations performed. Cost estimates to repair system defects are included with the recommended rehabilitation program. Recommendations to eliminate other sewer system problems such as conditions causing restrictions of flow are also addressed.

Wastewater collection systems in which extraneous flows (groundwater seepage or infiltration, and storm water sources or inflow) are either excluded or held to a minimum have recognizable benefits. These benefits would include:

- No overloaded or surcharged sewers as a result of extraneous flows (I/I) and the associated problems of wastewater backups and overflows.
- More efficient operation of the wastewater collection system.
- The use of the sewer hydraulic capacity for wastewater instead of infiltration/inflow.

The less apparent but usually more significant benefit of a leak-free or "tight" wastewater system can be lower overall capital and operating costs. Savings in costs result from:

- Extended life of existing wastewater collection system.
- Smaller future expansions of hydraulically sized components, such as sewers, pumping stations, and wastewater treatment processes.

## **1.2 Infiltration/Inflow Definitions**

To understand the terms used in this report, definitions of infiltration and inflow are presented in the following paragraphs:

### *Infiltration*

This consists of groundwater entering a sewer system, through such means as defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from, inflow.

### *Steady Inflow*

This includes the water discharged from foundation drains, and drains from springs and swampy areas.

### *Direct Inflow*

This consists of those types of inflow that have a direct storm-water runoff connection to the sanitary sewer and cause an almost immediate increase in wastewater flows during rainfall events. Possible sources are roof leaders, yard and area drains, manhole covers that are subject to sheet flow or ponding, cross connections from storm drains and catch basins, and combined sewers.

### *Delayed Inflow*

This consists of storm water runoff that may require several days or more to drain through the sewer system. This category of inflow can include the discharge of sump pumps from steady inflow as well as the slowed entry of surface water through manholes in ponded areas.

### *Total Inflow*

This is the sum of the direct inflow at any point in the system plus any flow discharged from the system upstream through overflows, pumping station bypasses, and the like.

## **1.3 Sanitary Sewer Survey**

The sanitary sewer survey was conducted to identify and quantify sources I/I as well as to evaluate the physical condition of the sanitary sewer collection system. The survey consisted of the following tasks and was performed in two phases:

1. Manhole Inspections (Performed in Phase I)
2. Smoke Testing (Performed in Phase I)
3. Gravity Sewer Cleaning and Television Inspections (Phase II)

Flow and rainfall monitoring was not conducted as part of the scope of this study. All inspections were videotaped. A copy of all closed-circuit television inspection logs, video tapes and photos have been submitted to NAS-JRB as supplemental documents provided by Specialized Maintenance Services, Inc..

### **1.3.1 Project Start-Up**

An existing sanitary sewer system map provided by the NAS-JRB Environmental Department contained information on manhole locations and line segment diameters. The existing sanitary sewer numbering system shown on the sanitary sewer map was used in this study. Additional features such as manholes found during this investigation that were not on the sewer map were given numbers utilizing the existing numbering system.

### **1.3.2 Gravity Sewer Cleaning/Television Inspection**

#### *Gravity Sewer Cleaning*

This task consisted of performing a “light” cleaning of up to an estimated 40,950 linear feet (LF) of the gravity sewer system as recommended in the Phase I Report by the use of high-pressure water. Light cleaning is defined as cleaning that is necessary to remove sand and loose, non-adhering materials from the lines (three (3) sweeps of the line). Tree roots that were encountered were not to be removed as part of the cleaning activity. Materials removed from the sewers during cleaning were disposed of offsite at an approved landfill in the City of Fort Worth. The gravity sanitary sewer segments that were cleaned are indicated on the sewer system map enclosed at the end of this report.

#### *Television Inspection*

This task also consisted of televising of up to an estimated 44,950 linear feet (LF) of the gravity sewer system. The television inspection was performed by introducing a color television camera into the system at appropriate manholes. A 1/2” VHS videotape was made of each gravity sewer segment inspected. The videotape includes information such as starting manhole, ending manhole, time, date and continuous footage readout. A computerized log of the findings in each sewer segment is provided in the supplemental documents to this report. Locations of obvious significant defects (i.e., cracked pipe, misaligned joints, leaking service connections, flat or “bellied” segments, and significant root intrusion) were captured on video, photographed, and logged on the inspection report. The gravity sewer segments that were televised are highlighted on the sewer system map enclosed at the end of this report.

## **1.4 Analysis**

After the completion of the field survey tasks, the collected field data was reviewed and a recommended rehabilitation program was developed. The analysis also includes cost estimates for improving the structural integrity and the condition of the wastewater collection system.



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## **2.0 BACKGROUND INFORMATION**

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### **2.1 General Background**

The Naval Air Station – Joint Reserve Base (NAS-JRB) at Fort Worth, Texas is located approximately 10 miles west of downtown Fort Worth. The base encompasses approximately 1,800 acres. Figure 2.1.1 is a site location map for NAS-JRB.

The major tenant units include the following:

- Fleet Logistics Support Wing
- Fleet Logistics Support Squadron 59
- Fighter Squadron 201
- 301<sup>st</sup> Fighter Wing
- 10<sup>th</sup> Air Force
- 136<sup>th</sup> Tactical Airlift Wing, Texas Air National Guard
- Marine Aircraft Group 41
- Marine Fighter Attack 112
- Marine Aerial Refueler Transport Squadron 234
- Naval Reserve Intelligence Command
- Naval Reserve Readiness Command
- 9<sup>th</sup> Naval Construction Regiment
- Naval Reserve Security Group Command
- 14<sup>th</sup> Marine Regiment

The NAS-JRB operates much like a small city by providing services for water, natural gas, and power distribution, wastewater and refuse collection, and police and fire protection. The base's population consists of military (active and reserve) and civilian personnel, including contract personnel, which number to more than 9,600. The base's support services for tenant commands covers an array of areas including airfield and runway operations, air traffic control, aircraft hanger facilities, aircraft maintenance, public safety, fire department, 398 bachelor quarters (officers and enlisted), 83 family housing units, galley, base library, Navy exchange, commissary, family service center, child development center, and medical clinic. The base recreational facilities include a fitness center, bowling alley, auto shop, ball fields, and marina.

### **2.2 Description of Existing Conditions**

The sanitary sewer system in the study area was designated as a separate sewer system to transport only wastewater flow exclusive of groundwater or storm water. Limited groundwater infiltration enters the sanitary sewer system based on observations made during the television inspections of the sewer system. The groundwater elevation at

**Figure 2.1.1 NAS-JRB Site Location Map**

NAS-JRB varies across the site but is typically 10 to 12 feet below grade. The depth of the sanitary sewers at NAS-JRB typically range between 4 and 10 feet below grade which places them above the groundwater table in most cases. For this reason, only a few defects were found with active infiltration during the Phase II evaluation.

According to NAS-JRB personnel, natural springs exist in the Fort Worth area with some located on base. One area where a spring is known to exist on base is along the north side Arnold Avenue in front of Building 1501. During the televising, infiltration was observed in the sewer located on the south side of Arnold. It is possible that the infiltration is occurring as a result of the spring's influence on the sewer.

### **2.3 Existing Collection System**

The existing wastewater collection system at the NAS-JRB as shown on the master engineering drawings consists of approximately 50,000 linear feet of gravity sewer lines not including service connections to buildings. Pipe diameters range from 4 inches to 15 inches for the gravity sewer lines. Piping materials used in construction of the gravity sewer lines consist of mostly clay and concrete although there are a few areas throughout the base where PVC and ductile iron pipe are installed. There are approximately 285 sanitary manholes associated with the sanitary sewer collection system. The majority of the sanitary manholes are constructed of brick sections with open pick hole type covers. The newer manholes are constructed of precast concrete sections. Wastewater flows by gravity, where it outfalls to the City of Fort Worth's sanitary sewer system.

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## 3.0 INSPECTION RESULTS

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A summary of the inspections performed at the NAS-JRB are included in this section. Tabulations of any structural defects found, problems observed, and I/I flows that were discovered during the television inspection of the wastewater collection system are provided. Any errors in the wastewater collection system utility drawings discovered during field work have been noted on the sanitary sewer map included at the end of this report. Copies of all closed-circuit television inspection log sheets, videotapes, and photographs are included in the supplemental documents provided by Specialized Maintenance Services, Inc..

### 3.1 Gravity Sewer Inspections

Gravity sewer inspection by internally televising selected sewer lines was performed as part of the inspection program in the sanitary sewer system. The purpose of the gravity sewer inspection is to determine major line defects and verify line segment continuity and pipe diameter. A general summary of the internal inspection results is given in Table 3.1.1. Data for each sewer segment televised during the Phase II evaluations are provided in Table 3.1.2.

Sewer segments that were inspected were constructed of PVC, vitrified clay, and concrete. A total of 203 line segments were identified during the Phase I study for television inspection. Of these, 188 pipe segments were inspected. Based on the results of the television inspections, 61 pipe segments were identified to require rehabilitation work. The 15 segments that were not accessible for inspections are listed in Table 3.1.3.

#### 3.1.1 Cleaning

The preparatory sewer cleaning element of the I/I study was undertaken to provide unobstructed access to the sewer system for internal inspection so that observation of the pipe interior was as clear as possible. The sewer lines selected for preparatory cleaning coincided with those lines selected for internal inspection. High pressure jet cleaning was the method used to clean the pipes.

High pressure jet cleaning was undertaken with a vehicle equipped with a water tank, high pressure water pump, and hose mounted on a power-retractable reel. The hose was equipped with a nozzle that set up a water jet capable of propelling the hose through the sewer pipe. When the hose reached the upstream manhole, it was power retracted with the water jet in operation. The scouring action removed and carried the debris to the downstream manhole where it was removed from the line with the vacuum that was mounted on the vehicle.

### 3.1.2 Televising

Internal television inspection of the sewer lines was conducted using a closed-circuit color television system. A small camera mounted on a motorized frame with tracks was pulled through the sewer. The camera was elevated to the approximate center of each pipe by attaching an appropriately sized crawler frame. Color video produced by the television camera was displayed on a monitor in the control van. From this location, the operator viewed the video being produced and controlled the light intensity and position and speed of the camera as it moved through the sewer. The station of the camera, as it moved through the sewer, was monitored by a device mounted on the control cable and electronically displayed on the video monitor in feet from the reference manhole.

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**TABLE 3.1.1 GRAVITY SEWER INTERNAL INSPECTION SUMMARY**

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**NAS-JRB FORT WORTH  
SEWER SYSTEM EVALUATION SURVEY**

<b>Sewer Pipe</b>	<b>Quantity</b>
Actual Lineal Feet of Sewer Cleaned	32,016
Actual Lineal Feet of Sewer Televised	33,103
Number of Sewers with Infiltration	8
Number of Sewers with Broken Pipe	29
Number of Sewers with Pipe Sags	15
Number of Sewers with Cracks	35
Number of Sewers with Severe Corrosion	6
Number of Sewers with Mineral Deposits	11
Number of Sewers with Collapsing Pipe	7
Number of Sewers with Severely Offset Joints	4
Number of Sewers with Roots	6
Protruding Service Connections	5

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**TABLE 3.1.2 GRAVITY SEWER INSPECTION RESULTS**

Upstream Manhole	Dnstream Manhole	Tape Number	Counter Start	Counter Stop	Televised Leng.ft.	Joint Leng. ft.	Pipe Matl.	Pipe Dia.In.	Summary of Observation	Insp Sht.
15O	15N	SMS 1	-	-	14.5	3	VCP	6	Camera blocked by debris	1
15O	15N	SMS 1	-	-	58	3	VCP	6	Camera blocked by debris	2
67	68	SMS 2	0:00:00	0:20:22	399.6	3	VCP	12	Pipe OK	3
69	70	SMS 2	0:20:22	0:36:36	82.9	6	VCP	12	Minor crack	4
71	72	SMS 2	0:36:36	1:09:14	400.7	6	VCP	12	Minor pipe crack	5
72	73	SMS 2	1:10:25	1:17:50	69.6	6	VCP	12	Minor crack	6
70	70A	SMS 2	1:17:50	1:30:50	167.7	6	VCP	12	Pipe sag	7
70A	71	SMS 3	0:00:00	0:07:01	13.7	6	VCP	12	Minor crack	8
73	74	SMS 3	0:07:01	0:17:56	124.6	6	VCP	12	Minor crack	9
74	75	SMS 3	0:18:15	0:45:25	301.2	6	VCP	12	Severe pipe cracks	10
75	76	SMS 3	0:45:25	1:05:35	300.2	6	VCP	12	Minor pipe cracks	11
76	77	SMS 3	1:05:35	1:24:36	333	6	VCP	12	Minor pipe crack	12
77	78	SMS 4	0:00:00	0:23:05	401.5	6	VCP	12	Severe pipe cracks	13
78	79	SMS 4	0:23:05	0:45:51	407.9	6	VCP	12	Pipe OK	14
79	80	SMS 4	0:45:51	1:03:27	392.6	6	VCP	12	Minor pipe crack	15
15O	15N	SMS 5	0:00:00	0:21:30	245.2	3	PVC	6	Minor pipe cracks	16
B3H	B3G1	SMS 5	0:21:30	0:26:05	61.1	3	Conc.	8	Pipe OK	17
B3G1	B3G	SMS 5	0:26:05	0:34:25	88	3	Conc.	8	Misaligned joint	18
B3G	B3F	SMS 5	0:34:25	0:36:30	2	3	Conc.	8	Heavy mineral deposits	19
B3G	B3F	SMS 5	0:36:30	0:49:00	197.2	3	Conc.	8	Heavy mineral deposits	20
B3F	B3E	SMS 5	0:49:00	0:57:55	105.1	3	Conc.	8	Minor pipe cracks	21
B3E	B3D	SMS 5	0:57:55	1:15:45	294.9	3	Conc.	8	Multiple pipe cracks	22
B3D	B3C	SMS 5	1:15:46	1:25:14	140	3	Conc.	8	Minor pipe cracks	23
B3C	B3B	SMS 5	1:25:30	1:33:17	71.6	3	Conc.	6	Minor pipe cracks	24
B6C	B6B	SMS 6	0:00:00	0:16:30	284.1	3	Conc.	8	Light roots at joints	25
B6B	B6A	SMS 6	0:16:30	0:31:45	250	3	Conc.	8	Light roots at joints	26
B6A1	B6A	SMS 6	0:31:45	0:44:01	160.1	3	Conc.	8	Minor pipe crack	27
B6A	B6	SMS 6	0:44:01	0:58:16	233.1	3	Conc.	8	Minor pipe crack	28
56	55	SMS 6	0:58:16	1:02:21	26.9	3	Conc.	8	Separated pipe joints	29
56	55	SMS 6	1:02:21	1:13:00	131.7	3	Conc.	8	Separated pipe joints	30
55	54	SMS 6	1:13:00	1:17:45	59.9	3	Conc.	8	Pipe sag	31
54	53	SMS 6	1:17:55	1:32:10	274.3	3	Conc.	8	Pipe OK	32
53	52	SMS 6	1:32:10	1:50:00	354	3	Conc.	8	Pipe OK	33
52	50	SMS 7	0:00:00	0:20:00	387.2	10	Conc.	8	Pipe sag	34
51	50	SMS 7	0:20:00	0:30:00	133.3	10	Conc.	8	Pipe OK MH 51 Oil/Water Sep.	35
50	49	SMS 7	0:30:00	0:35:55	94.6	10	Conc.	10	Pipe OK	36
49	48	SMS 7	0:35:55	0:54:30	345.9	10	Conc.	10	Minor pipe cracks	37
48	47	SMS 7	0:54:30	0:59:25	81.1	10	Conc.	10	Pipe OK	38
47	42	SMS 7	0:59:25	1:09:40	171.2	10	Conc.	10	Pipe sag	39
43	42	SMS 7	1:09:40	1:28:46	241.2	10	Conc.	8	Heavy mineral deposits	40
44	43	SMS 7	1:28:46	1:37:11	72.7	3	Conc.	8	Mineral deposits, MH 44 buried	41
4142A	4142B	SMS 8	0:00:00	0:19:00	300.0	3	PVC	6	Pipe OK	42
4142B	P	SMS 8	0:19:00	0:27:00	120.0	20	PVC	6	Pipe OK	43
Cleanout	100	SMS 8	0:27:00	0:45:10	319.0	20	PVC	8	Pipe OK	44
100	101	SMS 8	0:45:10	0:51:05	120.1	12	PVC	8	Pipe OK	45
101	102	SMS 8	0:51:05	1:06:05	290.0	12	PVC	8	Pipe OK	46
Cleanout	103	SMS 8	1:06:05	1:24:00	303.5	12	PVC	8	Pipe OK	47
103	102	SMS 8	1:24:00	1:39:10	318.9	12	PVC	8	Pipe OK	48
133	107	SMS 9	0:00:00	0:06:10	88.0	12	PVC	8	Broken pipe	49
107	106	SMS 9	0:06:10	0:18:05	189.7	12	PVC	8	Pipe OK	50

**TABLE 3.1.2 GRAVITY SEWER INSPECTION RESULTS (con't)**

Upstream Manhole	Dnstream Manhole	Tape Number	Counter Start	Counter Stop	Televised Leng.ft.	Joint Leng. ft.	Pipe Matl.	Pipe Dia.In.	Summary of Observation	Insp Sht.
106	105	SMS 9	0:18:05	0:31:15	221.9	12	PVC	8	Pipe OK	51
102	104	SMS 9	0:31:15	0:40:35	180.0	12	PVC	8	Pipe OK	52
104	105	SMS 9	0:40:35	0:47:25	121.3	12	PVC	8	Pipe OK	53
105	108	SMS 9	0:47:25	1:00:50	191.4	12	PVC	8	Misaligned joint	54
108	109	SMS 9	1:00:50	1:08:25	97.7	12	PVC	8	Pipe OK	55
109	110	SMS 9	1:08:25	1:20:15	210.4	12	PVC	8	Pipe OK	56
110	19-1	SMS 10	0:00:00	0:03:40	46.4	12	PVC	8	Pipe OK	57
19-1	19	SMS 10	0:03:40	0:16:10	204.7	3	VCP	8	Light roots	58
11D8	11D7	SMS 10	0:16:10	0:30:45	284.4	3	VCP	8	Broken pipe joint	59
11D7	11D6A	SMS 10	0:30:45	0:49:45	310.0	3	VCP	8	Broken pipe	60
11D6A	11D6	SMS 10	0:49:45	0:55:45	100.0	3	VCP	8	Misaligned joint	61
11D6	11D5	SMS 10	0:55:45	1:08:35	172.5	3	VCP	8	Broken pipe & sag	62
11D5	11D4	SMS 10	1:08:36	1:25:00	216.5	3	VCP	8	Broken pipe & 45 degree elbow	63
11D5	11D4	SMS 10	1:25:00	1:30:35	77.8	3	VCP	8	Broken pipe & 45 degree elbow	64
11D4	11D3	SMS 10	1:30:35	1:39:55	136.5	3	VCP	8	Misaligned joints	65
11D3	11D2	SMS 10	1:39:55	1:43:35	36.6	3	VCP	8	Pipe sag	66
11D2	11D1	SMS 10	1:43:35	1:47:50	30.7	3	Conc.	8	Heavy mineral deposits	67
11D1	11D1A	SMS 11	0:00:00	0:09:30	178.0	3	Conc.	8	Pipe OK	68
11L	11J	SMS 11	0:09:30	0:32:35	299.7	3	Conc.	8	Broken pipe	69
11J	11I	SMS 11	0:32:35	0:46:45	234.7	3	Conc.	8	Circular pipe cracks	70
11I	11H	SMS 11	0:46:45	0:49:45	4.0	3	Conc.	8	Protruding service connection	71
11I	11H	SMS 11	0:49:45	0:56:25	55.6	3	Conc.	8	Pipe collapse	72
11H	11G	SMS 11	0:56:25	1:02:40	59.5	3	Conc.	8	Broken pipe	73
11G	11F	SMS 11	1:02:40	1:24:35	281.3	3	Conc.	8	Broken pipe	74
11F	11E	SMS 11	1:24:35	1:34:35	177.0	3	Conc.	8	Light roots	75
11E	11D	SMS 12	0:00:00	0:12:51	239.6	3	Conc.	8	Pipe sag	76
11D1	11D	SMS 12	0:13:05	0:28:25	209.1	3	Conc.	8	Light roots	77
11DA	11D	SMS 12	0:28:25	0:50:20	288.0	3	VCP	8	Broken pipe	78
11D	11C	SMS 12	0:50:20	1:06:05	228.0	3	Conc.	8	Pipe sag	79
11C	11B	SMS 12	1:06:05	1:24:25	299.0	3	Conc.	8	Pipe OK	80
11B	11A	SMS 12	1:24:25	1:37:05	255.2	3	Conc.	8	Pipe OK	81
11A	11	SMS 12	1:37:05	1:57:10	305.0	3	Conc.	8	Pipe collapse	82
8C	8B	SMS 13	0:00:00	0:05:35	78.1	12	PVC	6	Pipe Ok	83
B16	B15A	SMS 13	0:05:35	0:19:00	225.3	3	Conc.	8	Circular pipe cracks	84
B15A	B15	SMS 13	0:19:00	0:25:45	132.9	3	Conc.	8	Circular pipe crack	85
B15	B14	SMS 13	0:25:45	0:32:50	130.0	3	Conc.	8	Broken pipe	86
B14	B14A	SMS 13	0:32:50	0:39:00	84.0	3	Conc.	8	Broken / offset joint	87
B14A	B13	SMS 13	0:39:00	0:50:20	172.8	3	Conc.	8	Broken / offset joint	88
B13A	B13	SMS 13	0:50:21	0:58:55	120.3	3	VCP	8	Pipe OK	89
B13	B12	SMS 13	0:58:55	1:11:30	186.7	3	Conc.	8	Pipe collapse	90
B13	B12	SMS 13	1:11:30	1:15:35	48.1	3	Conc.	8	Pipe collapse	91
B12	B12A	SMS 13	1:15:35	1:25:30	199.9	12	PVC	8	Pipe Ok	92
B10	B9	SMS 14	0:00:00	0:05:25	101.0	3	Conc.	8	Pipe Ok	93
B11	B10	SMS 14	0:05:25	0:18:45	263.4	3	Conc.	8	Pipe Ok	94
B9A	B9	SMS 14	0:18:45	0:26:10	105.3	3	Conc.	8	Pipe collapse	95
B9	B8	SMS 14	0:26:10	0:30:20	41.2	3	Conc.	8	Protruding service connection	96
B9	B8	SMS14	0:30:20	0:47:49	253.9	3	Conc.	8	Protruding service connection	97
Cleanout	15E11	SMS14	0:47:49	0:50:20	5.0	3	Conc.	8	Severe joint offset	98
15E11	1511A	SMS14	0:50:20	0:57:35	112.5	3	Conc.	8	Pipe sag and mineral deposits	99
1511A	15E10	SMS14	0:57:35	1:02:45	82.0	3	Conc.	8	Pipe Ok	100
15E10	15E9	SMS14	1:02:45	1:09:45	95.9	3	Conc.	8	Circular pipe crack	101



**TABLE 3.1.2 GRAVITY SEWER INSPECTION RESULTS (con't)**

Upstream Manhole	Dnstream Manhole	Tape Number	Counter Start	Counter Stop	Televised Leng.ft.	Joint Leng. ft.	Pipe Matl.	Pipe Dia.In.	Summary of Observation	Insp Sht.
End of Line	15E7B	SMS14	1:09:45	1:17:05	62.4	3	Conc.	8	Pipe OK	102
15E7B	15E7A	SMS14	1:17:05	1:23:40	69.7	3	Conc.	8	Heavy roots	103
15E7A	15E7	SMS14	1:23:40	1:27:15	39.8	3	Conc.	8	Pipe sag	104
15E8	15E7	SMS14	1:27:15	1:29:45	12.7	3	Conc.	8	Pipe collapse	105
15E7	15E6	SMS14	1:29:45	1:35:20	93.3	3	Conc.	8	Pipe sag	106
15E5	15E6	SMS14	1:35:20	1:36:10	1.0	3	Conc.	8	Heavy debris unable to jet clean	107
15E6	15E4	SMS 15	0:00:00	0:18:35	258.3	3	Conc.	8	Broken pipe	108
15E4A	15E4	SMS 15	0:18:35	0:36:45	235.5	3	Conc.	8	Broken pipe	109
15E4	15E3	SMS 15	0:36:45	0:47:20	192.3	3	Conc.	8	Mineral deposits	110
15E3	15E2	SMS 15	0:47:20	0:58:00	113.3	3	Conc.	8	Circular pipe cracks	111
15D2	15D1	SMS 15	0:58:00	1:24:05	441.9	3	Conc.	8	Circular pipe cracks	112
15D1	15D	SMS 15	1:24:05	1:37:55	137.6	3	Conc.	8	Circular pipe cracks	113
15I	15H	SMS 15	1:37:55	1:56:05	293.0	3	Conc.	8	Pipe cracks & missing pipe	114
15G2A	15G1	SMS 16	0:00:00	0:10:50	136.6	3	Conc.	8	Pipe OK	115
15G2	15G2A	SMS 16	0:10:50	0:18:20	98.7	3	Conc.	8	Severe offset joint	116
4E	4D	SMS 16	0:18:20	0:31:20	255.3	3	Conc.	8	Pipe OK	117
4D	4C	SMS 16	0:31:20	0:48:05	311.9	3	Conc.	8	Pipe OK	118
4C1	4C	SMS 16	0:48:05	0:52:25	29.2	3	Conc.	8	Protruding service connection	119
4C1	4C	SMS 16	0:52:25	1:00:25	86.5	3	Conc.	8	Protruding service connection	120
4C	4B	SMS 16	1:00:25	1:19:55	306.7	3	Conc.	8	Broken pipe & infiltration	121
8A	8	SMS 16	1:19:56	1:27:10	150.0	3	PVC	8	Pipe OK	122
8B	8A	SMS 16	1:27:10	1:44:00	374.2	12	PVC	8	Pipe OK	123
4A	4	SMS 17	0:00:00	0:12:45	265.9	3	Conc.	8	Concrete debris in MH 4A	124
9C	9B	SMS 17	0:12:45	0:31:40	268.0	3	Conc.	8	Circular cracks	125
9B	9A	SMS 17	0:31:40	0:45:25	183.2	3	Conc.	8	Mineral deposits & infiltration	126
9A	9	SMS 17	0:45:25	0:58:20	183.8	3	Conc.	8	Broken pipe & infiltration	127
9A	9	SMS 17	0:58:20	1:11:40	202.1	3	Conc.	8	Broken pipe & infiltration	128
13A3	13A2	SMS 17	1:11:40	1:24:05	148.8	3	Conc.	8	Pipe OK 45 degree elbow in line	129
13A3	13A2	SMS 17	1:24:05	1:32:40	97.9	3	Conc.	8	Pipe OK 45 degree elbow in line	130
13A2	13A	SMS 17	1:32:40	1:46:10	263.5	3	Conc.	8	Pipe sag	131
13A1	13A	SMS 18	0:00:00	0:13:50	197.5	3	Conc.	8	Broken pipe	132
End of Line	13E	SMS 18	0:13:50	0:17:10	14.7	3	Conc.	8	Pipe OK	133
13E	13D	SMS 18	0:17:10	0:20:25	37.8	3	Conc.	8	Broken joint	134
13D	13C	SMS 18	0:20:25	0:24:46	40.7	3	Conc.	8	Pipe OK 45 degree elbow in line	135
13D	13C	SMS 18	0:24:46	0:26:55	4.0	3	Conc.	8	Pipe OK 45 degree elbow in line	136
13C	13B	SMS 18	0:26:55	0:29:40	40.0	3	Conc.	8	Pipe OK	137
13B	13A	SMS 18	0:29:40	0:39:30	176.7	3	Conc.	8	Pipe OK	138
18B	18A	SMS 18	0:39:30	0:50:55	152.3	3	Conc.	8	Broken pipe	139
18A	18	SMS 18	0:50:55	1:01:46	139.6	3	Conc.	8	Pipe collapse	140
19	18	SMS 18	1:01:46	1:11:20	152.2	3	VCP	10	Offset joint	141
18	17	SMS 18	1:11:20	1:25:45	255.1	3	VCP	10	Offset joint	142
17	16	SMS 18	1:25:46	1:42:10	296.7	3	VCP	10	Pipe OK	143
16	15-1	SMS 19	0:00:00	0:13:10	264.7	3	VCP	10	Pipe crack	144
15D	15C	SMS 19	0:13:10	0:27:05	323.5	3	VCP	8	Pipe OK	145
15C	15B	SMS 19	0:27:05	0:35:50	155.1	3	VCP	10	Pipe OK	146
15B	15A	SMS 19	0:35:50	0:44:55	189.6	3	VCP	10	Pipe OK	147
15A	15	SMS 19	0:44:55	0:56:10	181.1	3	VCP	10	Multiple cracks & infiltration	148
15-1	15	SMS 19	0:56:10	1:04:30	123.8	3	VCP	10	Mineral deposits	149
15	14	SMS 19	1:04:30	1:20:58	257.0	3	Conc.	12	Broken pipe	150
13	12	SMS 19	1:20:59	1:34:40	272.7	3	Conc.	12	Multiple cracks & infiltration	151
12	11	SMS 20	0:00:00	0:15:10	222.6	3	Conc.	12	Multiple cracks & corrosion	152



**TABLE 3.1.2 GRAVITY SEWER INSPECTION RESULTS (con't)**

Upstream Manhole	Dnstream Manhole	Tape Number	Counter Start	Counter Stop	Segment Leng.ft.	Joint Leng. ft.	Pipe Matl.	Pipe Dia.In.	Summary of Observation	Insp Sht.
11	10	SMS 20	0:15:10	0:31:40	290.9	3	Conc.	12	Multiple crack & infiltration	153
10	9	SMS 20	0:31:40	0:47:40	252.3	3	Conc.	12	Circular pipe cracks	154
9	8	SMS 20	0:47:40	0:50:25	12.2	3	Conc.	12	Severe pipe corrosion	155
9	8	SMS 20	0:50:25	1:02:55	172.3	3	Conc.	12	Severe pipe corrosion	156
8	7	SMS 20	1:03:00	1:14:50	195.1	3	Conc.	12	Severe pipe corrosion	157
7	6	SMS 20	1:14:50	1:33:50	351.2	3	Conc.	12	Severe pipe corrosion	158
6	5	SMS 20	1:33:50	1:35:25	8.7	3	Conc.	12	Broken and cracked pipe	159
6	5	SMS 20	1:35:25	1:56:15	416.0	3	Conc.	12	Broken and cracked pipe	160
5	4	SMS 21	0:00:00	0:13:20	268.7	3	Conc.	12	Multiple cracks & corrosion	161
14	13F	SMS 21	0:13:21	0:21:12	103.0	3	Conc.	12	Broken & missing pipe	163
14	13F	SMS 21	0:21:20	0:26:30	86.9	3	Conc.	12	Broken & missing pipe	164
13F	14A	SMS 21	0:26:30	0:31:37	116.7	3	PVC	12	Pipe OK	165
14A	14B	SMS 21	0:31:37	0:33:50	41.4	3	PVC	12	Pipe OK	166
14B	13	SMS 21	0:33:50	0:39:45	103.0	3	PVC	12	Pipe OK	167
15G1	15G	SMS 21	0:39:45	1:00:25	293.5	3	Conc.	8	Broken pipe	168
15GX	15G1A	SMS 21	1:00:25	1:02:30	20.1	3	PVC	8	Pipe OK	169
15GX	15GY	SMS 21	1:02:30	1:04:40	35.0	3	PVC	8	Pipe OK	170
15GY	15GZ	SMS 21	1:04:40	1:06:55	37.0	3	PVC	8	Pipe OK	171
15GZ	15G	SMS 21	1:06:55	1:10:50	54.7	3	Conc.	8	Pipe OK	172
15G	15F	SMS 21	1:10:51	1:26:35	242.8	3	Conc.	8	Pipe OK	173
15F	15F1A	SMS 21	1:26:35	1:32:35	133.8	20	PVC	8	Pipe OK	174
15E1	15EAA	SMS 21	1:32:35	1:37:40	113.8	20	PVC	8	Pipe OK	175
B7A2	B7A1	SMS 22	0:00:00	0:06:40	141.9	3	Conc.	8	Pipe OK	176
B7A1	B7A	SMS 22	0:06:40	0:09:45	58.1	3	Conc.	8	Pipe OK	177
B8	B7	SMS 22	0:09:45	0:31:40	385.2	3	Conc.	8	Broken pipe	178
B3B	B3A	SMS 22	0:31:40	0:34:50	11.4	3	Conc.	8	Heavy debris	179
B7B	B7A	SMS 22	0:34:51	0:44:30	156.5	3	Conc.	15	Pipe OK	181
B7A	B7	SMS 22	0:44:30	0:48:55	60.8	3	Conc.	15	Pipe OK	182
B7	B7C	SMS 22	0:48:55	0:56:40	153	3	Conc.	15	Pipe OK	183
B7D	B7C	SMS 22	0:56:40	1:01:15	92.3	3	Conc.	15	Pipe OK	184
B7D	B6	SMS 22	1:01:15	1:11:55	203	3	Conc.	15	Pipe cracks	185
19B	19	SMS 22	1:11:55	1:40:10	424.9	3	VCP	8	Broken pipe	186
B12A	B11A	SMS 23	0:00:00	0:21:35	335.5	20	PVC	8	Pipe OK	187
112	113	SMS 23	0:21:35	0:28:40	135	20	PVC	8	Pipe OK	188
End of Line	112	SMS 23	0:28:40	0:32:35	17.5	20	PVC	8	Severe joint offset	189
7	7A2	SMS 23	0:32:35	0:36:15	57.1	20	PVC	8	Pipe OK	190
B6	B5	SMS 23	0:36:15	0:48:20	248.2	3	Conc.	15	Mineral deposits & infiltration	191
B5	B4	SMS 23	0:48:20	1:03:30	300	3	Conc.	15	Mineral deposits	192
69	70	SMS 23	1:03:30	1:14:25	291.7	3	VCP	12	Pipe cracks and sag	193
70A	71	SMS 23	1:14:25	1:25:45	272.6	3	VCP	12	Pipe cracks and sag	194
73	74	SMS 23	1:25:45	1:37:05	233.1	3	VCP	12	Pipe sag	195
42	40	SMS 23	1:37:05	1:46:30	149.5	3	Conc.	10	Offset joint	196

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**TABLE 3.1.3 INACCESSIBLE LINE SEGEMENTS**

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**NAS-JRB FORT WORTH  
SEWER SYSTEM EVALUATION SURVEY**

<b>Line Segment</b>	<b>Description</b>
B11A to B11	Fuel Tank Area; MHs are located on containment berm
4 to 3	Inverted Siphon Area
B4 to B4A	Line Diameter is 4 inch; unable to TV
44 to 45	Manholes 44, 45, and 46 are buried under Pavement
45 to 46	Manholes 44, 45, and 46 are buried under Pavement
B3A to B3	Line Segment is outside fence line in wooded area
B2 to B3	Line Segment is outside fence line in wooded area
B4 to B3	Line Segment is outside fence line in wooded area
B4 to B4A	Line Segment is outside fence line in wooded area
7A to 7A1	Line Diameter is 4 inch; unable to TV
B4B to B4	Line Diameter is 4 inch; unable to TV
B6D1 to B6	MH B6 could not be located; B6D1 is a storm manhole
B7E to B7D	Unable to get equipment in the line
113 to 114	Unable to open manhole 114 or to TV from 113 to 114
114 to 115	MH 114 is corroded shut and 115 has a raised cone - 4ft.
19B1A to 19B1	Unable to locate manholes
19B1 to 19B	Unable to open manholes, corroded shut
68 to 69	Unable to open manhole 68 or to TV from 69 to 68

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All of the video was recorded on tape and returned to the office for analysis. This permitted the results to be examined in a controlled environment allowing the tapes to be replayed as often as necessary to accurately determine the appropriate rehabilitation technique.

All recorded videos and photographs of the televised gravity sewer segments are provided to the NAS-JRB in the supplemental documents provided by Specialized Maintenance Services, Inc.. The gravity sewer inspection procedure included recording the following observations:

1. Manhole identification numbers for connecting sewer lines.
2. Direction of flow in pipes.
3. Pipe diameter and construction material.
4. Amount of root growth if any.
5. Amount and type of deposition.
6. Pipe structural condition and line/grade of pipe.
7. Visible infiltration in pipe.
8. Photographs of the defects.

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## 4.0 RECOMMENDED REHABILITATION

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### 4.1 Rehabilitation Summary

The recommended rehabilitation program is based on the field inspections that identified I/I sources and structural defects in the sanitary sewer system. Of the sanitary sewers that were inspected, 61 gravity line segments are recommended for rehabilitation. The recommended repair method, probable repair cost and priority repair ranking for each of the 61 segments are provided in Tables 4.1.1, 4.1.2, and 4.1.3 at the end of this section. The most severe defects are identified in Table 4.1.1. Defects that do not require immediate repair are addressed in Tables 4.1.2 and 4.1.3.

In addition to the 61 pipes identified for rehabilitation, 38 line segments have been selected for future monitoring. The line segments that warrant future monitoring are those that exhibited minor defects such as minor cracking, light roots, light mineral deposits, and light debris. While these defects at this time do not appear to be imposing any structural degradation or flow obstruction, they should continue to be monitored to document any changes. Table 4.2 at the end of this section provides a summary of the line segments recommended for future periodic monitoring.

### 4.2 Recommended Gravity Sewer Rehabilitation

Three types of sewer line rehabilitation, open cut spot replacement, pipe lining, and open cut line segment replacement, are recommended for the NAS-JRB system due to the structural nature of the observed defects. For broken or damaged pipe sections an open cut spot replacement is the recommended repair. This procedure would involve the removal of the damaged pipe section and replacement with a new PVC pipe section. When possible, the section of old pipe to be removed would extend from the nearest upstream structurally sound pipe joint to the nearest structurally sound joint downstream of the damaged section.

For deteriorated pipe segments, the repair method could be either replacement with new PVC pipe or lining by inserting a pipe sleeve, usually of polyethylene plastic or Insituform™. The method chosen depends primarily on the structural condition of the deteriorated pipe. Plastic insertion sleeves or liners are not structurally capable of carrying the same loads as standard sewer pipes and, therefore, should not be used in pipe sections which are structurally unsound.

A description of each segment defect(s) and recommended rehabilitation(s) for the NAS-JRB system is presented below and locations are illustrated on the sewer map enclosed at the end of this report.

**1. Manhole 74 to Manhole 75 – Inspection Sheet 10:**

This line exhibited severe cracking at the crown of the pipe and longitudinally along the spring line. The structural damage runs the full length of the pipe. The recommended rehabilitation is an open cut replacement of the line from manhole to manhole (approximately 300 ft.).

**2. Manhole 77 to Manhole 78 – Inspection Sheet 13:**

An open longitudinal crack 384.8 feet from Manhole 77 was identified. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 18 ft.).

**3. Manhole B3G to Manhole B3F – Inspection Sheet 19 and 20:**

Heavy mineral deposits in the line. The recommended rehabilitation is mechanical cleaning to remove the mineral deposits.

**4. Manhole B3E to Manhole B3D – Inspection Sheet 22:**

Severe pipe cracking at the crown 0 to 55 feet from Manhole B3E. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 55 ft.).

**5. Manhole 56 to Manhole 55 – Inspection Sheets 29 and 30:**

Separated and severely offset pipe 90 feet from Manhole 55. The recommended rehabilitation is an open cut replacement of the line from the offset to Manhole 56 (approximately 260 ft.).

**6. Manhole 43 to Manhole 42 – Inspection Sheet 40:**

Heavy mineral deposits in the line. The recommended rehabilitation is mechanical cleaning to remove the mineral deposits.

**7. Manhole 133 to Manhole 107 – Inspection Sheet 49:**

Broken pipe at 41.3 feet from Manhole 107. The recommended rehabilitation is an open cut spot repair of the damaged line segment (approximately 10 ft.).

**8. Manhole 11D8 to Manhole 11D7 – Inspection Sheet 59:**

Severe pipe cracking at 211.1 feet from Manhole 11D8. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**9. Manhole 11D7 to Manhole 11D6A – Inspection Sheet 60:**

Broken pipe and offset joints between 179 feet and 208 feet from Manhole 11D7. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 30 ft.).

**10. Manhole 11D6 to Manhole 11D5 – Inspection Sheet 62:**

Broken pipe and offset joints starting at 112.5 feet from Manhole 11D6 to Manhole 11D5. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 60 ft.).

**11. Manhole 11D5 to Manhole 11D4 – Inspection Sheet 63 and 64:**

Broken pipe and offset joints at 0 to 75 feet from Manhole 11D5. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 75 ft.).

**12. Manhole 11D1 to Manhole 11D2 – Inspection Sheet 67:**

Heavy mineral deposits in the line. The recommended rehabilitation is mechanical cleaning to remove the mineral deposits.

**13. Manhole 11L to Manhole 11J – Inspection Sheet 69:**

Broken pipe and offset joints starting at 190 feet from Manhole 11J to Manhole 11L. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 110 ft.).

**14. Manhole 11I to Manhole 11H – Inspection Sheets 71 and 72:**

Broken and collapsed pipe. The recommended rehabilitation is an open cut replacement of the line from manhole to manhole (approximately 320 ft.).

**15. Manhole 11H to Manhole 11G – Inspection Sheet 73:**

Broken and cracked pipe starting at 49 feet from Manhole 11H to Manhole 11G. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**16. Manhole 11G to Manhole 11F – Inspection Sheet 74:**

Broken and collapsed pipe starting at 72 feet from Manhole 11G to Manhole 11F. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 210 ft.).

**17. Manhole 11DA to Manhole 11D – Inspection Sheet 78:**

Broken pipe at 59 feet from Manhole 11DA and severe cracking starting at 240 feet from Manhole 11DA to Manhole 11D. The recommended rehabilitation is an open cut spot repair of the broken pipe and replacement of the two damaged line segments (approximately 10ft. and 50 ft.).

**18. Manhole 11A to Manhole 11 – Inspection Sheet 82:**

Broken pipe at 217.5 feet from Manhole 11A and severe cracking starting at 295 feet from Manhole 11A to Manhole 11. The recommended rehabilitation is an open cut spot repair of the broken pipe and replacement of the two damaged line segments (approximately 10 ft. and 10 ft.).

**19. Manhole B15 to Manhole B14 – Inspection Sheet 86:**

Broken pipe at 217.5 feet from Manhole 11A and severe cracking starting at 295 feet from Manhole 11A to Manhole 11. The recommended rehabilitation is an open cut spot repair of the broken pipe and replacement of the two damaged line segment (approximately 10 ft. and 10 ft.).

**20. Manhole B14 to Manhole 14A – Inspection Sheet 87:**

Severe pipe cracking starting at 72 feet from Manhole 14 to Manhole 14. The recommended rehabilitation is an open cut replacement of the damaged line segments (approximately 20 ft.).

**21. Manhole B14A to Manhole B13 – Inspection Sheet 88:**

Severe pipe cracking starting at 5 feet from Manhole B13 to Manhole B13. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**22. Manhole B13 to Manhole B12 – Inspection Sheets 90 and 91:**

Collapsed pipe starting at 8 feet from Manhole B12 to Manhole B12. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**23. Manhole B9A to Manhole B9 – Inspection Sheet 95:**

Collapsed pipe starting at 98 feet from Manhole B9 to Manhole B9A. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 252 ft.).

**24. Manhole B9 to Manhole B8 – Inspection Sheet 96 and 97:**

Protruding service connection at 40 feet from Manhole B9. The recommended rehabilitation is an open cut spot replacement of the service connection (approximately 10 ft.).

**25. C.O. to Manhole 15E11 – Inspection Sheet 98:**

Severe pipe offset and open joints. The recommended rehabilitation is an open cut replacement of the line segment from cleanout to manhole (approximately 300 ft.).

**26. Manhole 15E7B to Manhole 15E7A – Inspection Sheet 103:**

Heavy roots at joints. The recommended rehabilitation is mechanical cleaning to remove the roots.

**27. Manhole 15E8 to Manhole 15E7 – Inspection Sheet 105:**

Severe pipe corrosion along the entire length of the line. The recommended rehabilitation is an installation of a pipe liner (Insituform™) from manhole to manhole (approximately 200 ft.).

**28. Manhole 15E6 to Manhole 15E5 – Inspection Sheet 107:**

Heavy debris in the line. Line segment requires mechanical cleaning.

**29. Manhole 15E5 to Manhole 15E4 – Inspection Sheet 108:**

Broken pipe between 0 and 20 feet from Manhole 15E5. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 20 ft.).

**30. Manhole 15E4A to Manhole 15E4 – Inspection Sheet 109:**



Broken and cracked pipe starting at 169 feet from Manhole 15E4A to Manhole 15E4. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 131 ft.).

**31. Manhole 15I to Manhole 15H – Inspection Sheet 114:**

Severe pipe cracking between 0 and 60 feet from Manhole 15I, and broken pipe at 149, 174, and 274 feet from Manhole 15H. The recommended rehabilitation is an open cut replacement of the four damaged line segments (approximately 60 ft., 10 ft., 10 ft., and 10 ft.).

**32. Manhole 15G2 to Manhole 15G2A – Inspection Sheet 116:**

Severe offset pipe section at 72 feet from Manhole 15G2A. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**33. Manhole 4C to Manhole 4B – Inspection Sheet 121:**

Broken pipe with infiltration at 169 feet from Manhole 4C. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**34. Manhole 4A to Manhole 4 – Inspection Sheet 124:**

Large concrete debris in Manhole 4A. The recommended rehabilitation is for the debris to be removed.

**35. Manhole 9B to Manhole 9A – Inspection Sheet 126:**

Mineral deposits at pipe joints with infiltration along the entire length of pipe. The recommended rehabilitation is an installation of a pipe liner (Insituform™) from manhole to manhole (approximately 183 ft.).

**36. Manhole 9A to Manhole 9 – Inspection Sheets 127 and 128:**

Infiltration at break-in service connection 183 feet from Manhole 9A. The recommended rehabilitation is an open cut replacement of the service connection (approximately 10 ft.).

**37. Manhole 13A1 to Manhole 13A – Inspection Sheet 132:**

Broken pipe at 0 to 20 feet and 59 feet from Manhole 13A1. The recommended rehabilitation is an open cut replacement of the two damaged line segments (approximately 20 ft. and 10 ft.).

**38. Manhole 13E to Manhole 13D – Inspection Sheet 134:**

Cracked pipe joint at 13 feet from Manhole 13E. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**39. Manhole 18B to Manhole 18A – Inspection Sheet 139:**

Broken pipe at 107 feet from Manhole 18A. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**40. Manhole 18A to Manhole 18 – Inspection Sheet 140:**

Collapsed pipe starting at 11 feet from Manhole 18 to Manhole 18. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 11 ft.).

**41. Manhole 15A to Manhole 15 – Inspection Sheet 148:**

Infiltration at a pipe joint 131 feet from Manhole 15A. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**42. Manhole 15 to Manhole 14 – Inspection Sheet 150:**

Broken pipe starting at 208 feet from Manhole 15 to Manhole 14. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 50 ft.).

**43. Manhole 13 to Manhole 12 – Inspection Sheet 151:**

Severe pipe cracking with infiltration along the entire length of pipe. The recommended rehabilitation is the installation of a pipe liner (Insituform<sup>TM</sup>) from manhole to manhole (approximately 273 ft.).

**44. Manhole 12 to Manhole 11 – Inspection Sheet 152:**

Pipe corrosion along the entire length of the pipe. The recommended rehabilitation is the installation of a pipe liner (Insituform™) from manhole to manhole (approximately 223 ft.).

**45. Manhole 11 to Manhole 10 – Inspection Sheet 153:**

Severe pipe cracking with infiltration along the entire length of pipe. The recommended rehabilitation is the installation of a pipe liner (Insituform™) from manhole to manhole (approximately 291 ft.).

**46. Manhole 10 to Manhole 9 – Inspection Sheet 154:**

Pipe corrosion along the entire length of the pipe. The recommended rehabilitation is the installation of a pipe liner (Insituform™) from manhole to manhole (approximately 252 ft.).

**47. Manhole 9 to Manhole 8 – Inspection Sheets 155 and 156:**

Severe pipe corrosion, cracking, and missing pipe along the entire length of the line. The recommended rehabilitation is an open cut replacement of the line segment from manhole to manhole (approximately 300 ft.).

**48. Manhole 8 to Manhole 7 – Inspection Sheet 157:**

Severe pipe corrosion, cracking, and missing pipe along the entire length of the line. The recommended rehabilitation is an open cut replacement of the line segment from manhole to manhole (approximately 195 ft.).

**49. Manhole 7 to Manhole 6 – Inspection Sheet 158:**

Severe pipe corrosion, cracking, and missing pipe along the entire length of the line. The recommended rehabilitation is an open cut replacement of the line segment from manhole to manhole (approximately 351 ft.).

**50. Manhole 6 to Manhole 5 – Inspection Sheets 159 and 160:**

Severe pipe corrosion, cracking, and missing pipe along the entire length of the line. The recommended rehabilitation is an open cut replacement of the line segment from manhole to manhole (approximately 425 ft.).

**51. Manhole 5 to Manhole 4 – Inspection Sheet 161:**

Severe pipe corrosion, cracking, and missing pipe along the entire length of the line. The recommended rehabilitation is an open cut replacement of the line segment from manhole to manhole (approximately 269 ft.).

**52. Manhole 14 to Manhole 13F – Inspection Sheets 163 and 164:**

Severe pipe offset and corrosion starting at 101 feet from Manhole 14 to Manhole 13F. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 100 ft.).

**53. Manhole 15G1 to Manhole 15G – Inspection Sheet 168:**

Broken and cracked pipe at 80 and 260 feet from Manhole 15G1. The recommended rehabilitation is an open cut repair of the two damaged line segments (approximately 10 ft. and 10 ft.).

**54. Manhole B8 to Manhole B7 – Inspection Sheet 178:**

Broken pipe starting at 287 feet from Manhole B8 to Manhole B7. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 100 ft.).

**55. Manhole B3B to Manhole B3A – Inspection Sheet 179:**

Heavy debris in line. The recommended rehabilitation is mechanical cleaning of the line manhole to manhole (approximately 350 ft.).

**56. Manhole 19B to Manhole 19 – Inspection Sheet 186:**

Broken pipe at 138 and 168 feet from Manhole 19B. The recommended rehabilitation is an open cut repair of the two damaged line segments (approximately 10 ft. and 10 ft.).

**57. C.O. to Manhole 112 – Inspection Sheet 189:**

Separated pipe joint at 18 feet from Manhole 112. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**58. Manhole B6 to Manhole B5 – Inspection Sheet 191:**

Separated pipe joint with infiltration at 176 feet from Manhole B6. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**59. Manhole 69 to Manhole 70 – Inspection Sheet 193:**

Broken pipe joint at 277 feet from Manhole 69. The recommended rehabilitation is an open cut repair of the damaged line segment (approximately 10 ft.).

**60. Manhole 70A to Manhole 71 – Inspection Sheet 194:**

Severe pipe cracks at 66 and 142 feet from Manhole 70A. The recommended rehabilitation is an open cut replacement of the two damaged line segments (approximately 10 ft. and 10 ft.).

**61. Manhole 42 to Manhole 40 – Inspection Sheet 196:**

Severe offset pipe section at 97 feet from Manhole 42. The recommended rehabilitation is an open cut replacement of the damaged line segment (approximately 10 ft.).

**TABLE 4.1.1 GRAVITY SEWER REHABILITATION SUMMARY  
FOR DEFECTS REQUIRING IMMEDIATE REPAIR**

Up Stream MH	Down Stream MH	Line Length (feet)	Dia. (in.)	Buried Depth (feet)	Defect	Rehabilitation Method	Insp. Sht.
74	75	301.2	12	5.0	Severe cracking	Open cut replacement (300')	10
56	55	350.0	8	7.5	Separated pipe sections	Open cut replacement (260')	29,30
11I	11H	320.0	8	4.0	Collapsed pipe	Open cut replacement (320')	71,72
11G	11F	281.3	8	6.5	Collapsed pipe	Open cut replacement (210')	74
B14	B14A	84.0	8	10.5	Severe cracking	Open cut spot repair (20')	87
B14A	B13	172.8	8	10.5	Severe cracking	Open cut spot repair (10')	88
B13	B12	186.7	8	6.5	Collapsed pipe	Open cut spot repair (10')	90,91
B9A	B9	350.0	8	5.5	Collapsed pipe	Open cut replacement (252')	95
C.O.	15E11	300.0	8	9.5	Severe offsets	Open cut replacement (300')	98
15E8	15E7	200.0	8	6.0	Severe corrosion	Pipe liner (200')	105
15E4A	15E4	300.0	8	8.0	Broken pipe	Open cut replacement (131')	109
9B	9A	183.2	8	11.0	Infiltration	Pipe liner (183')	126
18A	18	139.6	8	5.0	Collapsed pipe	Open cut spot repair (11')	140
13	12	272.7	12	12.0	Cracking & infiltration	Pipe liner (273')	151
12	11	222.6	12	17.0	Pipe corrosion	Pipe liner (223')	152
11	10	290.9	12	6.0	Cracking & infiltration	Pipe liner (291')	153
10	9	252.3	12	6.0	Pipe corrosion	Pipe liner (252')	154
9	8	300.0	12	6.5	Severe corrosion	Open cut replacement (300')	155,156
8	7	195.1	12	8.0	Severe corrosion	Open cut replacement (195')	157
7	6	351.0	12	5.5	Severe corrosion	Open cut replacement (351')	158
6	5	425.0	12	4.0	Severe corrosion	Open cut replacement (425')	159,160
5	4	268.7	12	7.0	Severe corrosion	Open cut replacement (269')	161
14	13F	200.0	12	4.0	Pipe offset & corrosion	Open cut replacement (100')	163,164
C.O.	112	250.0	8	14.0	Separated pipe joint	Open cut spot repair (10')	189
B6	B5	248.2	15	13.0	Separated pipe joint	Open cut spot repair (10')	191
<b>Phase 1 Subtotal</b>							

**TABLE 4.1.2 GRAVITY SEWER REHABILITATION SUMMARY  
FOR DEFECTS REQUIRING REPAIR BEFORE JUNE 2000**

Up Stream MH	Down Stream MH	Line Length (feet)	Dia. (in.)	Buried Depth (feet)	Defect	Rehabilitation Method		Insp. Sht.
77	78	401.5	12	6.0	Longitudinal crack	Open cut spot repair (18')		13
133	107	88.0	8	4.0	Broken pipe	Open cut spot repair (10')		49
11D7	11D6A	310.0	8	5.0	Broken pipe	Open cut spot repair (30')		60
11D6	11D5	172.5	8	5.0	Broken pipe	Open cut replacement (60')		62
11D5	11D4	295.0	8	5.0	Broken pipe	Open cut replacement (75')		63, 64
11L	11J	299.7	8	7.5	Broken pipe	Open cut replacement (110')		69
11H	11G	59.5	8	5.0	Broken pipe	Open cut spot repair (10')		73
11DA	11D	288.0	8	10.0	Broken pipe	2 Spot repairs (10', 50')		78
11A	11	305.0	8	17.0	Broken pipe	2 Spot repairs (10', 10')		82
B15	B14	130.0	8	10.5	Broken pipe	2 Spot repairs (10', 10')		86
15E6	15E4	258.3	8	6.0	Broken pipe	Open cut spot repair (20')		108
15I	15H	293.0	8	5.5	Severe cracking	4 Spot Repairs (60', 10', 10', 10')		114
15G2	15G2A	98.7	8	6.0	Severe joint offset	Open cut spot repair (10')		116
4C	4B	306.7	8	7.0	Broken pipe	Open cut spot repair (10')		121
9A	9	386.0	8	10.0	Broken connection	Open cut spot repair (10')		127, 128
13A1	13A	197.5	8	7.0	Broken pipe	2 Spot repairs (20', 10')		132
13E	13D	37.8	8	6.5	Cracked joint	Open cut spot repair (10')		134
18B	18A	152.3	8	5.0	Broken pipe	Open cut spot repair (10')		139
15	14	257.0	12	10.0	Broken pipe	Open cut replacement (50')		150
15G1	15G	293.5	8	5.0	Broken pipe	2 Spot repairs (10', 10')		168
B8	B7	385.2	8	10.0	Broken pipe	Open cut replacement (100')		178
19B	19	424.9	8	7.0	Broken pipe	2 Spot repairs (10', 10')		186
69	70	291.7	12	4.0	Broken pipe	Open cut spot repair (10')		193
42	40	149.5	10	8.0	Severe pipe offset	Open cut spot repair (10')		196
<b>Phase 2 Subtotal</b>								

**TABLE 4.1.3 GRAVITY SEWER REHABILITATION SUMMARY  
FOR DEFECTS REQUIRING REPAIR BEFORE JUNE 2001**

Up Stream MH	Down Stream MH	Line Length (feet)	Dia. (in.)	Buried Depth (feet)	Defect	Rehabilitation Method		Insp. Sht.
B3G	B3F	200.0	8	9.5	Heavy mineral deposits	Mechanical cleaning (110')		19,20
B3E	B3D	294.9	8	6.5	Severe crack	Open cut spot repair (55')		22
43	42	241.2	8	12.5	Heavy mineral deposits	Mechanical cleaning (110')		40
11D8	11D7	284.8	8	5.0	Severe cracking	Open cut spot repair (10')		59
11D2	11D1	100.0	8	7.5	Heavy mineral deposits	Mechanical cleaning (132')		67
B9	B8	295.0	8	5.5	Protruding connection	Open cut spot repair (10')		96,97
15E7B	15E7A	69.7	8	8.5	Heavy roots	Mechanical cleaning (122')		103
15E5	15E6	150.0	8	6.5	Heavy debris	Mechanical cleaning (210')		107
4A	4	265.9	8	7.0	Debris in MH 4A	Debris removal		124
15A	15	181.1	10	10.0	Infiltration at joint	Open cut spot repair (10')		148
B3B	B3A	350.0	8	6.0	Heavy debris	Mechanical cleaning (350')		179
70A	71	272.6	12	7.5	Severe cracks	2 Spot repairs (10',10')		194
<b>Phase 3 Subtotal</b>								



**TABLE 4.2 GRAVITY SEWERS TO BE MONITORED**

Upstream Manhole	Downstream Manhole	Televised Leng.ft.	Joint Leng. ft.	Pipe Matl.	Pipe Dia.In.	Defect to be Monitored	Insp Sht.
69	70	82.9	6	VCP	12	Minor crack	4
71	72	400.7	6	VCP	12	Minor pipe crack	5
72	73	69.6	6	VCP	12	Minor crack	6
70A	71	13.7	6	VCP	12	Minor crack	8
73	74	124.6	6	VCP	12	Minor crack	9
75	76	300.2	6	VCP	12	Minor pipe cracks	11
76	77	333	6	VCP	12	Minor pipe crack	12
79	80	392.6	6	VCP	12	Minor pipe crack	15
150	15N	245.2	3	PVC	6	Minor pipe cracks	16
B3G	B3F	200.0	3	Conc.	8	Heavy mineral deposits	20
B3F	B3E	105.1	3	Conc.	8	Minor pipe cracks	21
B3D	B3C	140	3	Conc.	8	Minor pipe cracks	23
B3C	B3B	71.6	3	Conc.	6	Minor pipe cracks	24
B6C	B6B	284.1	3	Conc.	8	Light roots at joints	25
B6B	B6A	250	3	Conc.	8	Light roots at joints	26
B6A1	B6A	160.1	3	Conc.	8	Minor pipe crack	27
B6A	B6	233.1	3	Conc.	8	Minor pipe crack	28
49	48	345.9	10	Conc.	10	Minor pipe cracks	37
43	42	241.2	10	Conc.	10	Heavy mineral deposits	40
44	43	72.7	3	Conc.	8	Mineral deposits	41
19-1	19	204.7	3	VCP	8	Light roots	58
11D2	11D1	30.7	3	Conc.	8	Heavy mineral deposits	67
11J	11I	234.7	3	Conc.	8	Circular pipe cracks	70
11F	11E	177.0	3	Conc.	8	Light roots	75
11D1	11D	209.1	3	Conc.	8	Light roots	77
B16	B15A	225.3	3	Conc.	8	Circular pipe cracks	84
B15A	B15	132.9	3	Conc.	8	Circular pipe crack	85
15E10	15E9	95.9	3	Conc.	8	Circular pipe crack	101
15E7B	15E7A	69.7	3	Conc.	8	Heavy roots	103
15E4	15E3	192.3	3	Conc.	8	Mineral deposits	110
15E3	15E2	113.3	3	Conc.	8	Circular pipe cracks	111
15D2	15D1	441.9	3	Conc.	8	Circular pipe cracks	112
15D1	15D	137.6	3	Conc.	8	Circular pipe cracks	113
9C	9B	268.0	3	Conc.	8	Circular pipe cracks	125
16	15-1	264.7	3	VCP	10	Pipe crack	144
15-1	15	123.8	3	VCP	10	Mineral deposits	149
B7D	B6	203	3	Conc.	15	Pipe cracks	185
B5	B4	300	3	Conc.	15	Mineral deposits	192

